2358

K/DSA-1265

ORGDP

OAK RIDGE GASEOUS DIFFUSION PLANT

MARTIN MARIETTA

SAFETY ASSESSMENT

K-25 Shutdown:
Reactive Gas Disposal in K-402-9 Scrubbers

H. F. Hartman

September 6, 1985

OPERATED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

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Process Engineering Division
Safety Analysis Department

MARTIN MARIETTA ENERGY SYSTEMS, INC.
Oak Ridge, Tennessee

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APPROVALS

K-25 Shutdown: Reactive Gas Disposal in K-402-9 Scrubbers

D R Kellogg — Sept 6, 1985
B. A. Hannaford — Date
Process Engineering Safety Analysis

E. L Arnold — 9-6-85
E. L. Arnold — Date
Project Engineer

S. R. Humphreys — Sept. 6, 1985
S. R. Humphreys — Date
Standby Plant Representative

J G Rogers — Sept. 9, 1985
J. G. Rogers, Chairman — Date
ORGDP Environmental, Health, and
Safety Council

SAFETY ASSESSMENT

K-25 Shutdown: Reactive Gas Disposal in K-402-9 Scrubbers

1. INTRODUCTION

The reactive materials fluorine (F_2) and chlorine trifluoride (ClF_3) are now contained in drums at the Oak Ridge Gaseous Diffusion Plant (ORGDP). These gases will be used for cell treatment after the ORGDP Isotopic Cascade is placed in a standby condition. Disposal of both the reactive gases used in treatment of cells and the remaining reactive gases in drums will be done by mixing diluted reactive gases with a potassium hydroxide (KOH) solution in the K-402-9 scrubbers. Residual gases will pass through the scrubber and be discharged to the atmosphere through an existing vent. This safety assessment addresses the proposed disposal method.

2. SUMMARY

The safety aspects associated with the disposal of reactive gases in the K-402-9 scrubbers were examined and no further safety documentation is required. The proposed method of using the scrubbers is similar to the existing method with the major difference being the quantity of reactive gas. Reactive gases will be diluted, gas flow to the scrubber will be controlled, and the temperature of the scrubber will be monitored to assure that reasonable reaction conditions are occurring. Existing and approved Criticality Safety Analyses (CSAs) will apply for the cell treatment reactive gas case where traces of UF_6 may be in the gases going to the scrubber.

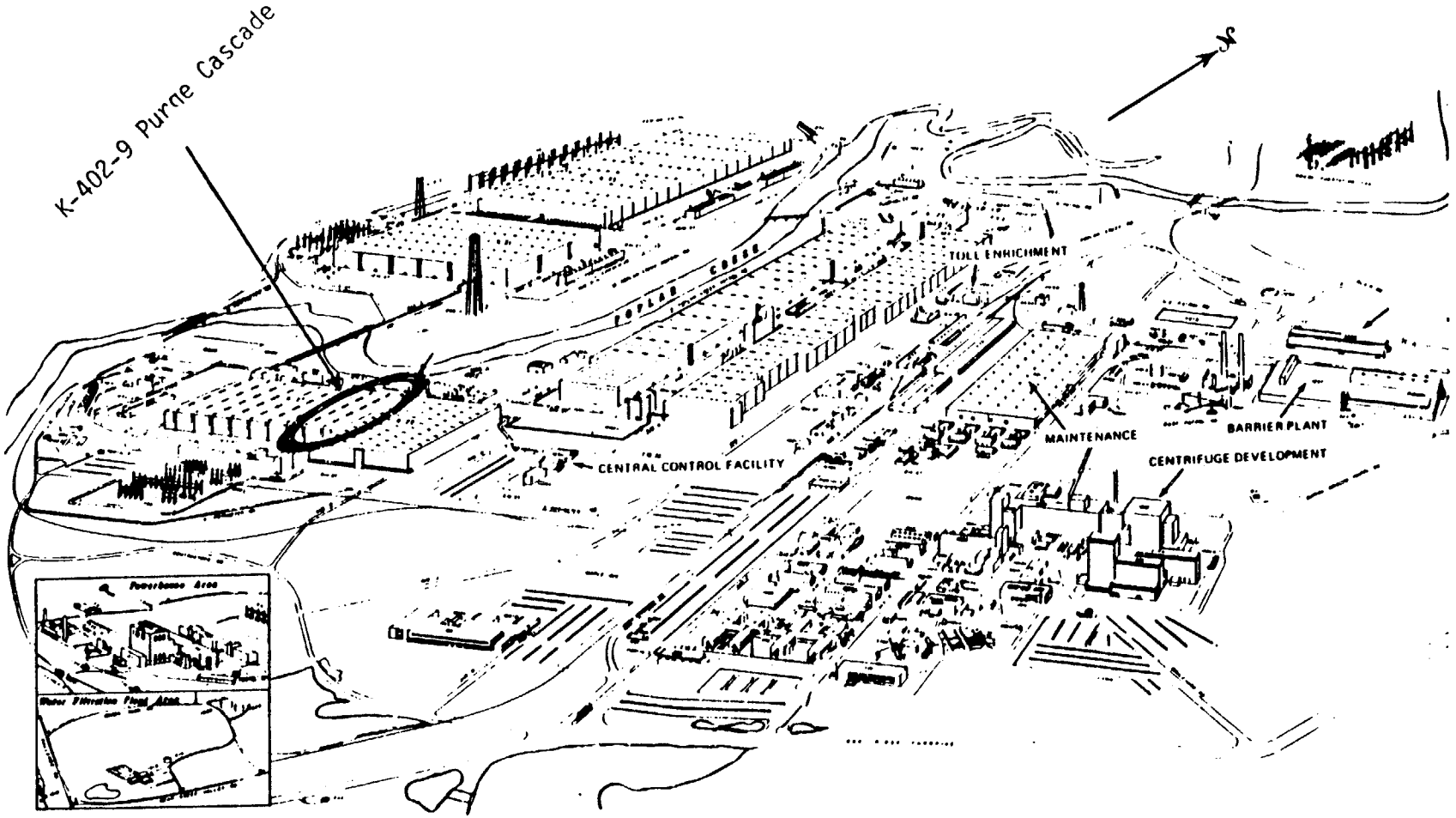
3. SITE

The K-402-9 Purge Cascade Scrubbers location is shown on Fig. 3-1.

4. FACILITY/PROCESS DESCRIPTION

A schematic diagram for Reactive Gas Disposal using the K-402-9 Scrubbers is shown in Fig. 4-1. This figure is based on the specific operating procedures shown in Attachment 1 (taken from the July 19, 1985 GDP Shutdown Procedure), the Attachment 2 memo of July 1, 1985 proposing this method and the Attachment 3 text and diagram of the newer scrubber system (taken from the ORGDP FSAR, K/D-5604, March 1985).

A quantity of reactive gases now exists in drums. This material and additional material, as required, will be used for cell treatment. Gases from the cell treatment and material remaining in drums will need to be disposed. The two scrubber systems in K-402-9 will be used alternately for the disposal.

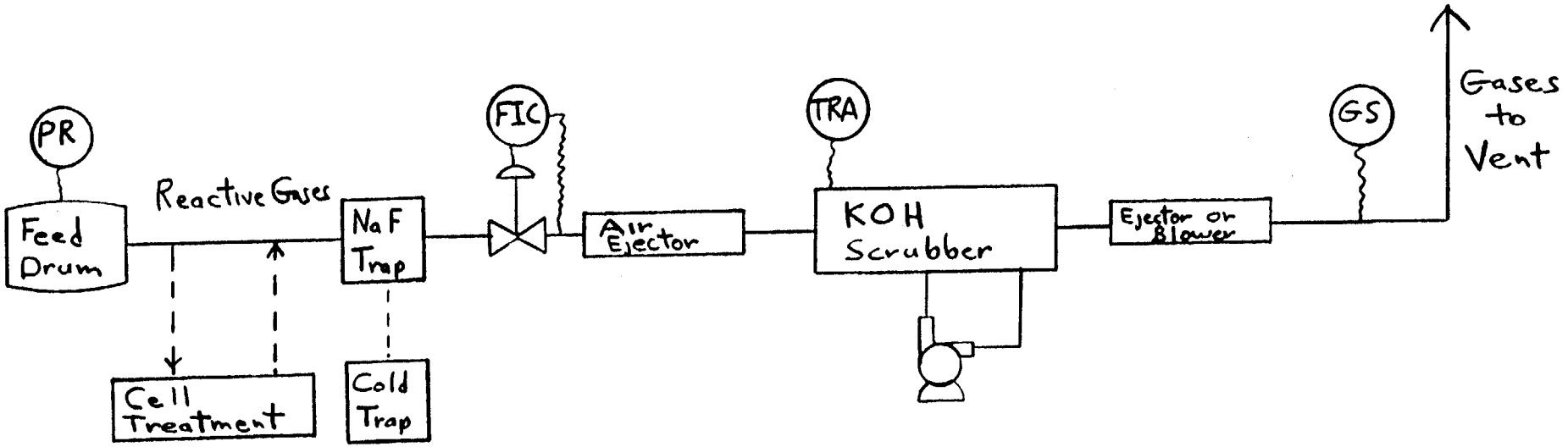


Oak Ridge Gaseous Diffusion Plant

Figure 3-1

Figure 4-1

Schematic Diagram for
Reactive Gas Disposal in K-402-9 Scrubbers



FIC = Flow Indicator Controller
GS = Gas Sampler
PR = Pressure Recorder
TRA = Temperature Recorder and
High Temperature Alarm

The method of disposal of the reactive gases involves.

- diluting the reactive gas and pressurizing the system;
- feeding the reactive gas (either from the feed drum or cell treatment lines) through sodium fluoride (NaF) traps, a flow controller, and an air ejector;
- reacting the gas with KOH in the scrubber, where 4 thermocouples on the scrubber inlet and 2 thermocouples on the KOH drain line permit the scrubber temperature to be monitored;
- discharging the residual gas to the atmosphere via a water ejector (newer scrubber) or blower (older scrubber) and discharge vents;
- purging the drum or line with air.

Operating conditions for the proposed method of disposing reactive gases are compared with the usual scrubber conditions. The quantities of fluorides shown as going to the atmosphere from the scrubber vent correspond to the present and requested State of Tennessee environmental discharge permits.

		Scrubber Operation Present	Reactive Gas Disposal Proposed
Fluorides (lb/day)	Feed	20	50
	Removed in KOH Solution	19.6	45
	Discharged to atmosphere	0.4	5 max
Air Feed (No. 1 Jet)		480 scfm	Similar
Scrubber Temperature		90 to 100°F	130 to 140°F

5. HAZARDS ANALYSIS

The potential hazards associated with this method of disposal of reactive gases involve excessive reaction rates which could result in temperature excursions. Diluting the reactive gases, regulating the feed flow, and monitoring the scrubber temperature will enable the reactions to be controlled.

The usual hazards of handling these gases and potassium hydroxide apply. Standard operating procedures, training and experience, and equipment design are expected to prevent accidental exposure to the hazards and mitigate the consequences of exposure if it occurs.

The K-402-9 scrubbers are designed and have been used for treating reactive gases including those containing trace quantities of UF_6. The (increased) quantity of reactive gas is the main difference between the proposed disposal method and the existing scrubbing method.

Criticality Safety Analyses (CSAs) and operating procedures exist for the equipment involved in reactive gas disposal. The applicable CSAs are listed for this geometrically safe designed equipment used in processing gases that contain trace quantities of UF_6.

Item	RCSA	K-29-PC	Approved	Op. Procedures
Older Scrubber	991	02	10-26-82	405.14
Newer Scrubber-(NS)	1119	16	7-2-84	405.14A
NS Solution	1205	17	6-21-85	-
NaF Traps (Older)	212	06	8-26-77	405.11
NaF Traps (Newer)	1080	14	3-6-84	405.10
Cold Trap for Desorbing UF_6 from NaF Traps	1212	Pending	Pending	Pending

Attachments for K/DSA-1265 Safety Assessment
for
K-25 Shutdown: Reactive Gas Disposal in
K-402-9 Scrubbers

Attachment 1	Reactive Gas Disposal Procedures and System Diagram; Procedures for Purging the K-33 Treatment Drums (from July 19, 1985 ORGDP Shutdown Procedures)
Attachment 2	Proposal for Using Scrubbers to Destroy Reactive Gases (from July 1, 1985 Memo)
Attachment 3	Description and Diagram of Newer Scrubber System (from March 1985 ORGDP FSAR K/D-5604)

The removal of F_2 and ClF_3 from storage drums will be accomplished by connecting the drums through existing piping to the suction of the K-27-9 top metering station air ejector and into the KOH scrubber system for removal of fluorides and chlorides.

The rate of disposal for the reactive gases will be governed by the air quality permit and the amount of heat generated within the KOH scrubber from the reaction of KOH with the F_2 and/or ClF_3. Specific flow rates will be determined on a daily basis.

F_2 Disposal From K-631 J, K, and L Drums

	Valves Open	Valves Closed
K-631	FMB BS7B BS6B	BS1B
K-27-1		NFH1 NFH2
K-27-7	NFH6	NFH3 NFH4 NFH5

At this point the F_2 drums (J, K, & L) are valved to the K-27-8 NaF trap station. Set up valving on a standby NaF trap to pass the F_2 into and through to the suction of the K-27-9 air ejector and to the KOH scrubber. The flow of F_2 will be controlled by FIC-114 at the K-27-8 NaF trap station.

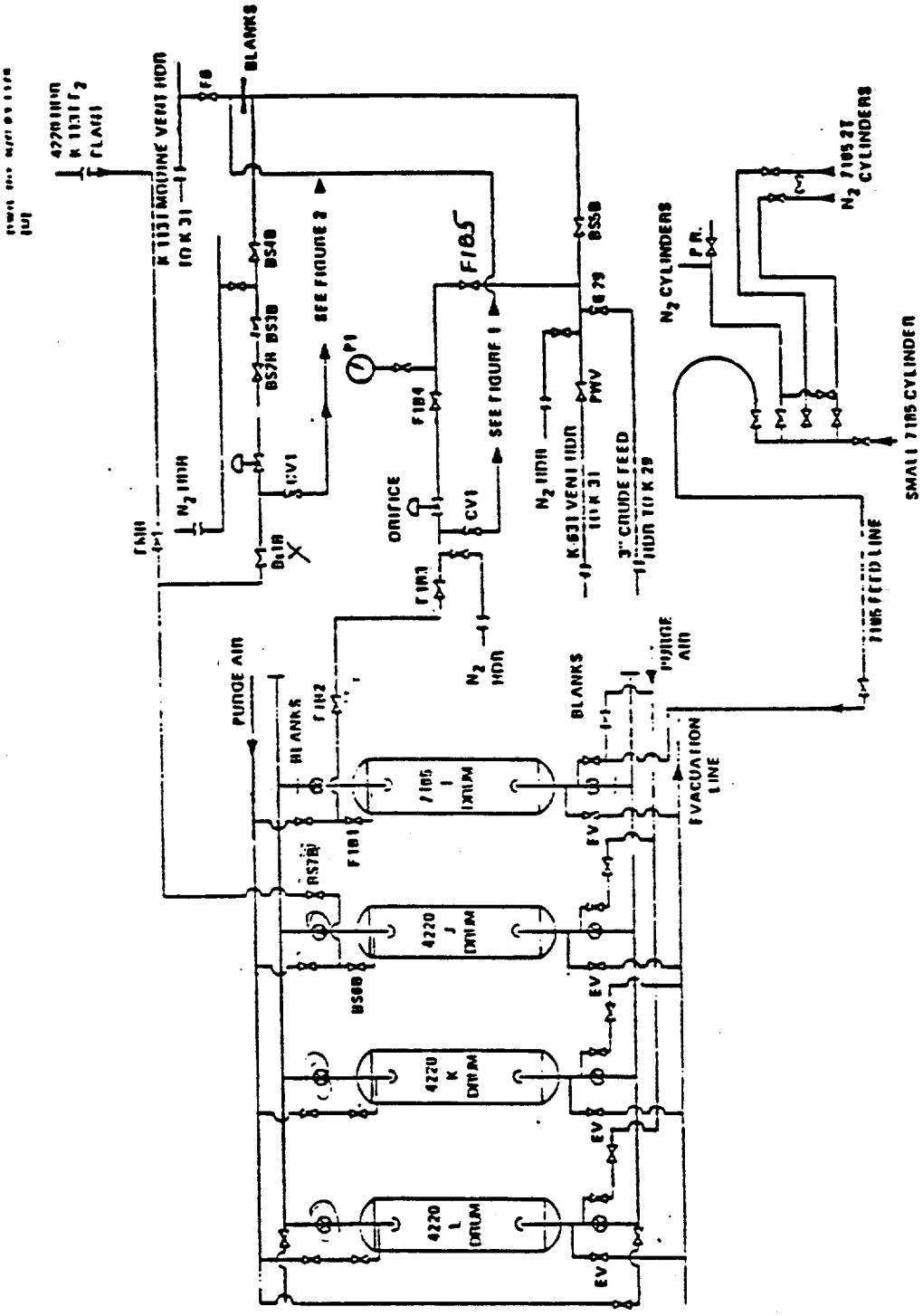
NOTE: The F_2 transfer header to the K-32 area can be valved into the K-27-8 NaF trap station by opening valves BS1B, BS2B, BS3B, BS4B, BS5B, and PWV in addition to the previously mentioned valving.

ClF_3 Disposal From K-631, I Drum

	Valves Open	Valves Closed
K-631	F1B1 F1B2 F1B3 F1B4 F1B5 BS4B BS3B BS2B BS1B FMB	BS7B (isolates F_2 drums) 6-29 PWV
K-27-1		NFH1 NFH2
K-27-7	NFH6	NFH3 NFH4 NFH5

At this point the ClF_3 drum (I) is valved to the K-27-8 NaF trap station. Set up valving on a standby NaF trap to pass the ClF_3 into and through to the suction of the K-27-9 air ejector and to the KOH scrubber. The flow of ClF_3 will be controlled by FIC-114 at the K-27-8 NaF trap station.

NOTE: The ClF_3 transfer header to the K-32 area can be valved into the K-27-8 NaF trap station by opening valve PWV in addition to the previously mentioned valving pertaining to ClF_3 disposal.


BLANKS
SEE FIGURE 2
SEE FIGURE 1
ORIFICE
PURGE AIR
BLANKS
EVACUATION LINE
N2 CYLINDERS
SMALL 7185 CYLINDER
7185 FEED LINE
3" CRUDE FEED
4220 L DRUM
4220 J DRUM
4220 K DRUM
7185 L DRUM
EV

K 6.11

PURGING THE K-33 TREATMENT DRUMS AND THE P.G. RETURN HEADER IN K-31 AND K-33

1. The K-29 area will evacuate the treatment gas drums and P.G. return header via the top purge jet in the scrubber.

2. Upon request of the K-29 area open valves: K-31-27CB, CXR, 2RB, 3RB, 31RB33; K-33-K18PRB1, BMSBP, K18PRB2, 18PRB3, 27PRB, 36PRB, PRCSB, and the appropriate storage and holding drum valves, depending on which gas is to be evacuated.

3. During the evacuation of the treatment gases, both the K-33 storage drums and holding drums should be evacuated. (Note: Be sure valves to cascade are closed at K-33-5.1 station.)

4. After all drums are evacuated isolate the storage drums by closing valves FL1, CF1 and BMSBP.

5. Open valves PRCSB, PR4HD, 4HD, PR3HD, 3HD, PR2HD, 2HD, PR1HD, 1HD, 36PRB, 27PRB, 18PRB3, K18PRB2.

6, Purge the holding drums by opening purge valve at drums and closing and opening K18PRB1. Also purge drum sample lines.

7. When drum purging is complete close valves PR4HD, 4HD, PR3HD, 3HD, PR2HD, 2HD, PR1HD, 1HD, and PRCSB, and all drum purge valves.

8. Open holding drum valve 4HD1, the #4 drum purge valve, and valve HDB.

9. Open valves FLHDB, CLHDB, FLAO, CFAO, and BMSBP at storage drums.

10. This will purge the 3/4" header between the storage drums and the holding drums.

11. After approximately 30 seconds close the #4 drum purge valve, 4HD1 and HDB valves.

12. Close FLHDB, CLHDB and BMSBP valves at storage drums.

13. Open valves PRCS2, open purge valve on north 45AX crossover, open valve 45AXPR. Purge the north end of the P.G. return header by this method for at least 30 seconds.

14. Close the crossover purge valve, 45AXPR, PRCS2, 36PRB, 27PRB, 18PRB3 and K18PRB2.

15. Sample for a negative at the holding drums and at 18PRB2.

16. With K-29 area continuing to evacuate, open valve FL1, CF1 and BMSBP, at storage drums.

17. Close K-33 valve K18PRB1 and open valve TGP and the purge valve at the storage drums.

18. Open valve FLAO, FLABF, CFAO, CFABP, BMS1 and BMS2.

19. Open and close K18PRB1 several times to batch purge the storage drums.

20. During the purging operation the drum sample station should also be purged.

21. When the storage drums are adequately purged, and evacuated, isolate system by closing K-31 valve 31RB33. Sample for a negative at the storage drum sample station.

22. If negative is obtained, pressure to 17 psia.

23. Close valves FL1, CF1, FLHDB, CLHDB, FLAO, FLABP, CFAO, CFABP, TGP, BMSBP, BMS1, BMS2, K18PRB1.

24. With K-29 area still pulling on P.G. return header, open K-31 valves 4RB, 5RB, the unit 6 crossover purge valve and 6RX.

25. After approximately 30 seconds close the crossover purge valve, and 6RX valve.

26. Request a sample be pulled in the K-29 area.

27. If negative is obtained, notify K-29 area and pressure the line to 17 psia.

28. Close K-31 valves 5RB, 4RB, 3RB, 2RB, CXR, and 27CB.

MARTIN MARIETTA ENERGY SYSTEMS, INC.

July 1, 1985

R. L. Faulkner

Use of the KOH Scrubbers to Destroy Fluorine and ClF_3

There are 610 pounds of fluorine and 868 lb ClF_3 at atmospheric pressure in drums at ORGDP. A method of destroying these gases safely and without violating the air quality permit has been devised. The gases should be diluted with air and reacted with KOH in the scrubbers in 402-8 and 402-9.

Findings

These gases should be diluted with air and fed to the KOH scrubbers at the rate of 100 lb/day gas. *The two scrubbers should be operated alternately. The old scrubber will operate about 3.5 days before the gas flow must be switched to the new scrubber, and the old scrubber blowndown. The new scrubber will operate 1.75 days before the flow must be switched back to the old scrubber and the new scrubber blowndown. About 23 gallons/day more KOH than is now being added must be added to the scrubber.

If the scrubbers are good evaporators, the heat generated by the reaction of KOH with the treatment gas will evaporate about 100 more gallons of water each day which must be replaced by either plant water or the water in the 45% KOH solution. The temperature of the scrubber will increase to 130-140°F. The efficiency of the scrubber will be less at this temperature, but the discharge should still meet the permit limits. By engineering judgement, the scrubbers should be able to evaporate this much water to remove the heat of reaction. Under normal operating conditions the scrubbers are easily able to evaporate enough water to remove the heat of reaction. Before starting the cell treatments, temperature and pressure indicators should be installed on both scrubbers. The flow of ClF_3 to the scrubbers should be increased gradually and the scrubbers should be monitored carefully to determine if the scrubbers will be able to evaporate enough water to balance the heat of reaction.

The destruction of these gases will consume 960 gallons KOH which will cost $1,700.

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* Present 9/85 plans are to feed 50 lb/day

Recommendations

1. 100 lb per day *of these gases should be diluted with air and sent to the KOH scrubber.

2. Pressure and temperature indicators should be installed on the KOH scrubbers.

3. The flow of ClF_3 or F_2 to the scrubbers should be increased gradually and the temperature and pressure of the scrubber monitored carefully.

4. If equipment failures or other problems occur during the destruction of these gases, the cell treatments must be stopped until after the problem is solved.

D H Bunch
D. H. Bunch, K-1401, MS-387 (6-0201)

DHB:lpv

cc: R. D. Bundy
H. T. Conner
K. D. Estes
File - DHB (NoRC)

* Present 9/85 plans are to feed 50 lb per day

4.1.6.2.9 Scrubber System

Fluorides and chlorides exist in the gaseous diffusion plants in the form of fluorine, HF, ClF_3, and heavier compounds such as R-114 and UF_6. Uranium hexafluoride is separated from the vent gas by the diffusion process. R-114 is vented and the remainder of the gases are active, soluble materials which are trapped by a wet caustic scrubber system prior to discharge. The vent is monitored to assure compliance with emission standards. Potassium hydroxide, a caustic solution, neutralizes the acid gases. The spent solution is periodically transported to a holding pond for disposal.

Figure 4.1.6-17 is a schematic diagram of the vent gas scrubber located in K-402-9. The scrubber vessel is a horizontal, cylindrical, stainless steel vessel, approximately 36 in. in diameter and 20 ft long. It contains five spray nozzles in series, with an inspection port in each compartment.

The drain from the scrubber flows to a safe geometry storage header where it is picked up and recirculated back to the spray nozzles in the scrubber vessel. As the fluoride and chloride concentrations increase, signalled by an increase in the specific gravity of the solution, a portion of the solution is removed to a holding tank and replaced by fresh KOH solution.

The system is about 99% efficient for the removal of soluble fluorides and chlorides. The vent gas UF_6 content at the scrubber inlet averages 5 to 10 ppm, and the system is about 80% efficient in removing this; therefore, the scrubber solution usually contains small quantities of enriched uranium. The uranium content is too low for economical recovery, so the trace amounts are disposed of along with the fluoride and chloride salts after the solution sampled and analyzed for uranium content, as described in 4.4.4.3.5. All system equipment is designed to be geometrically safe and is approved by nuclear criticality safety specialists.

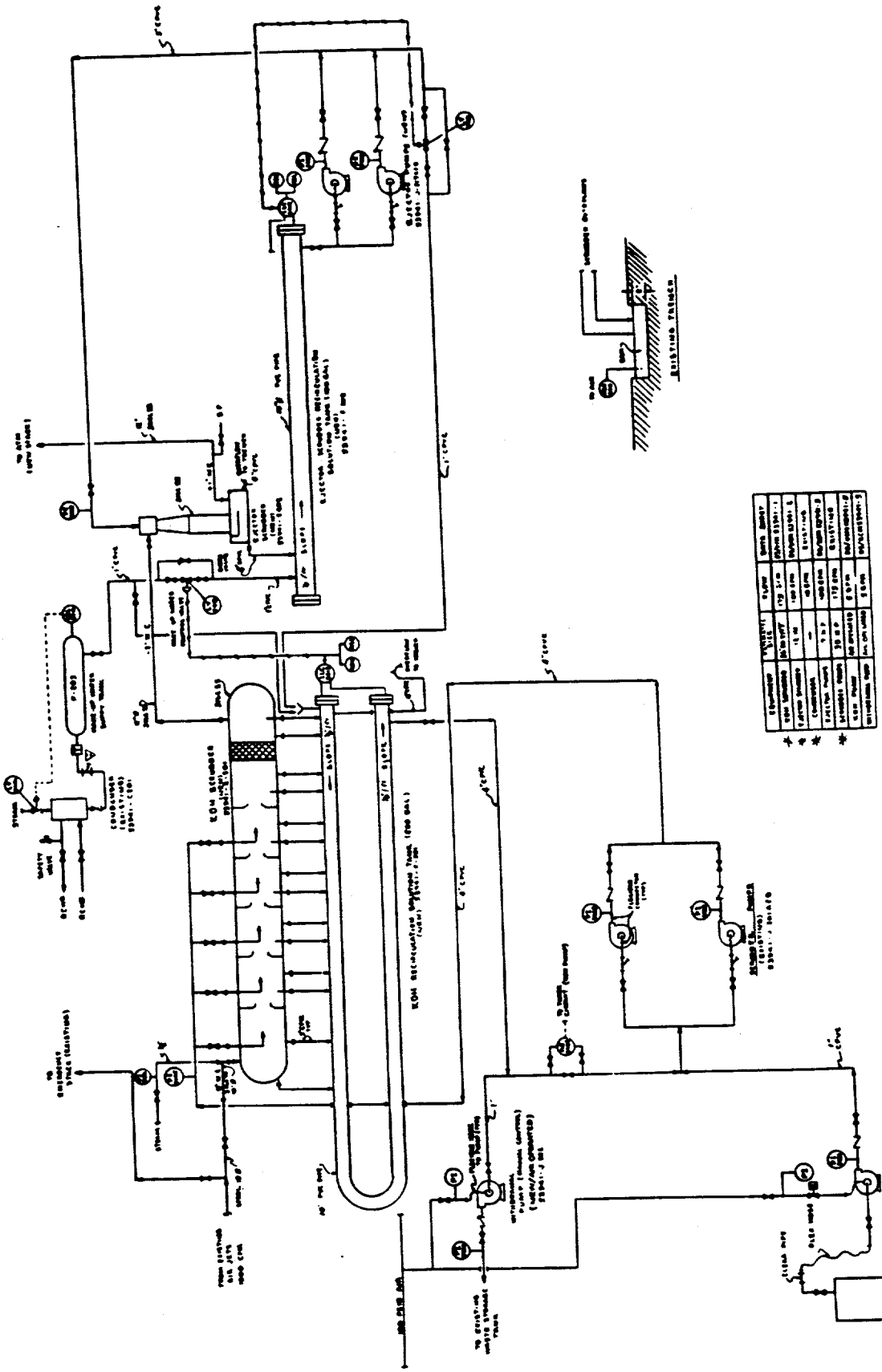

Figure 4.1.6-17
KOH SCRUBBER SYSTEM FLOW SHEET